'De-Skilling,' Skilled Commodities, and the *NIC*s' Emerging Competitive Advantage

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The dynamics of comparative advantage are such that the level of productivity in a sector in country *A* may be lower than in country *B*, but *A* may out-compete *B* if *A*'s rate of growth of productivity is higher. In what follows, I bet on the skilled branches in the newly industrializing countries (*NIC*s) as the dark horse of international trade in the belief that gains in productivity are greatest in such fields. I show why this might be so in terms of a paradox: how it is that the transfer of technology can be most effective in a sector where the process of "de-skilling" has progressed the least. Because de-skilling has been far from complete, a world of three inputs is reality and trade among developing countries (South-South trade) is misperceived if three inputs are collapsed into two.

The high skill content of South-South trade, corroborated in recent empirical work, is taken as presumptive evidence of the *NIC*s emerging competitiveness in the skilled manufacturing branches. My interpretation of the small body of literature on the large question of technology in the *NIC*s is designed to illuminate why such countries compete better in fields where the human factor is greatest, compared to other industries also of recent origin in such countries which are machine paced or process centered. The *NIC*s competitiveness in industries which rely upon large quantities of unskilled labor has long been demonstrated in exports to the North, so they are ignored here.

I. The Tendency to De-Skill, but the Persistence of Skilled Workers and Skilled Sectors

A lively debate has been sparked by the work of H. Braverman (1974) on the issue of whether or not there occurs a process of de-skilling as countries accumulate capital and advance technologically. The debate is of interest to trade theorists insofar as it bears upon technology transfer, and hence the commodity composition of trade. Although no one appears to have considered explicitly the relationship between de-skilling in the industrialized economies and the transmission of production methods to newly industrializing ones, it seems reasonable to imagine that where de-skilling occurs, there emerges a two-factor world (labor and capital), with skills as a third element in production dropping out of the picture. The transfer of technology might be said to be facilitated with de-skilling insofar as one might suppose the skilled trades to be least amenable to international diffusion: knowledge of the production process stays locked in the experience of skilled workers, despite the efforts of management to wrest control from them (Braverman, 1974), and skilled production processes, more than most others, remain "tacit" rather than codifiable in blueprints (Richard Nelson and Sidney Winter, 1977).

The proposition of de-skilling follows directly from the writings of Smith and Marx on the division of labor. With the finer subdivision of tasks, the floodgates are opened to the application of machinery because specialized labor becomes simplified.

In certain respects, both the product cycle and Heckscher-Ohlin-Samuelson (H-O-S) models of international trade implicitly accept the de-skilling hypothesis. In the early stages of the product cycle, skills resurface temporarily with the advent of new technology, and there is a halt to technology transfer. In the end, however, the production process becomes standardized, skill content is

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reduced, we are back to two-factors, and technology transfer recommences. The two-factor implication of de-skilling gives the H-O-S model its explanatory power. Trade proceeds on the basis of a polarization of countries and commodities according to their relative endowments and intensities of capital and labor. When skills are considered explicitly, they are lumped together with capital (not labor), so that a two-way classification continues.

While technology transfer may accelerate with a decrease in manual skills, it may be arrested by an increase in intellectual skills, although it is not intuitively obvious where to draw the dividing line between the two. The problems of technology transfer once the complication of intellectual skills is introduced are either ignored (technology is assumed to be universal in the H-O-S model); or they are implicitly assumed to exist only when countries misbehave and skip over stages in the chain of comparative advantage (otherwise one stage of production automatically prepares the way technically for the next stage; Bela Balassa, 1977); or they are minimized, that is, the end of the product cycle is seen to involve relatively invariant technology which may be acquired either through foreign licenses or foreign investments.

While there may be a tendency towards de-skilling, reality is not quite so simple because science has not been wholly successful in transforming production. If one takes de-skilling and the "capital" in capitalism seriously, then one would expect the technological norm to be characterized by large amounts of capital per unit of unskilled labor. Yet this particular factor configuration appears to be the exception rather than the general rule. Certain commodities may be said to have altogether evaded capitalist production *techniques* (but not "relations") insofar as they are produced with little capital but with large doses of unskilled labor (for example, clothing and wood products). The techniques of other commoditites (say, chemicals and basic metals) still require large quantities of both capital and skills. Finally, some commodities are typically produced with little capital but with large amounts of skilled labor (nonelectrical machinery, ships).

Clearly, then, the realities of production indicate not the two-factor world which de-skilling would suggest but rather a three-factor one. As R. M. Stern (1976) and others have argued, the empirical evidence supports treating capital and skills not as substitutes but as complements, although not perfect ones.

While it may be warranted to aggregate capital and skills for certain purposes, for others doing so may prove distortive. This appears to be the case when one considers South-South trade in manufactures, which in 1979 accounted for 36 percent of manufactured exports from the South to the world.[1] Some have held high hopes for South-South trade insofar as they have viewed it as a way for southern countries to develop "intermediate" technology; to establish economic ties on which closer political bonds could coalesce; to raise productivity in more sophisticated manufactures; and to avert involvement in the depressions which recurrently grip the industrial heartlands. Others, however, have viewed it with a jaundiced eye: a two-factor generalized H-O-S model leads to the prediction of greater capital intensity (and hence resource misallocation) in manufactured exports to the developing than developed countries. In fact, it was argued early on that South-South trade in manufactures is marked by a heavy reliance on skilled labor (see my 1980 article). This has been corroborated by strenuous econometric exercises at the World Bank which include factor content analyses as well as regressions for more countries, commodities, years, and proxies for capital and skills. The results of either method show more unskilled labor per unit of exports to the North than the South. But the southern flow employs only marginally more capital and overwhelmingly more skills than the northern flow.

[1] In discussions of South-South trade, manufactures are variously defined. The 36 percent is based on manufactures defined as SITC 5–8 minus 68.

II. Technological Creativity in the Skilled Sectors by Comparison with Sectors using More Capital

South-South trade may be taken as presumptive evidence of the emerging competitiveness of skilled industries. Thus, skeptics of "revealed comparative advantage" notwithstanding, I assume that the rate of growth of productivity of skilled industries in the South is greater than the rate of growth of productivity of the remainder of industries in the South, as well as greater than the rate of growth of productivity of skilled industries in the North relative to other northern industries. Given the unimportance to date of skilled exports from the South to the industrialized countries, it may be inferred that the fast rate of growth of productivity of such exports has only just begun (assuming that the markets of the industrialized countries are most difficult to penetrate).[2] There is even some evidence from an early period of a faster rate of growth of productivity in high skill sectors if such sectors are taken to be capital and durable consumer goods; that is, between 1968 and 1974, before the upsurge in capital goods production in many *NIC*s, the rate of growth of productivity of capital and consumer goods in 16 *LDC*s was 3.3 percent compared to only 1.5 percent for mainly nondurable consumer goods and 2.6 percent for intermediate goods (UNIDO, 1979).

The assumption that the South is developing a competitive edge in skilled goods may strike an unrealistic note given the supposed problems of transferring the presumptively tacit technology of such goods. Further, the productivity gap between developed and developing countries has been predicted to be smallest the more process centered or machine paced the industry, and to be greatest the larger the role played by skills (W. Arthur Lewis, 1965). However: tests of the mechanization hypothesis have tended to be inconclusive (although conceivably because most are based on weak data which predate the upsurge of manufacturing in *NIC*s in the 1970's (Simon Teitel, 1981)); no tests look at rates of change of productivity although the dynamics of the situation warrant this; and none explicitly tests for the relationship between productivity differences and skills. Moreover, it is just as reasonable to imagine a priori that process-centered, machine-paced industries will be relatively least efficient as most efficient in the South. Because the division of labor is most highly developed in such industries, efficient production demands complex coordination at the level of the firm, complementary support services at the industry level, etc. For this reason, while productivity at the point of production may be expected to equalize internationally in process-centered and machine-paced industries, it may be expected to vary enormously at levels more remote from the pipeline or shopfloor.

To explain further why skilled goods may be gaining a competitive advantage, I focus on the technological characteristics of one component of South-South trade—capital goods. I do so despite the fact that many capital goods, even when defined to exclude passenger motor vehicles, are most notable for their high capital requirements (for example, heavy electrical equipment). These capital goods, however, tend in the general case to be traded far less than the others, especially nonelectrical machinery (C. T. Saunders, 1978). Capital goods, moreover, account for only 15–30 percent of total South-South trade in manufactures, depending on definitions. It will be assumed, nevertheless, that their production characteristics are generalizeable to other skilled exports.

The main finding of research on the technological activity of the *NIC*s—for all industries and for indigenous firms mainly—is that it exists. The second finding is that firms resort at discrete turning points in their growth to foreign sources of technology. Third, a large part of the technological activity of the *NIC*s is devoted merely to assimilating foreign sources. Another part is devoted to adapting foreign designs to suit

[2] It is possible that the *NIC*s export a higher *value* of skilled manufactures to the North than the South, but this doesn't appear to be the case.

local conditions: descaling, converting from mass to batch production, reducing imported raw material requirements, etc. Fourth, adaptive engineering, as it might be termed, only rarely gives rise to innovations at the technological frontier. The modifications to which it does give rise, however, may account in some unknown part for the attractiveness of southern exports in southern markets. Further, small, incremental innovations are responsible for rather sizeable productivity gains over time. Fifth, the *NIC*s have advanced much further in production engineering (efficient operation of plant) than in systems engineering (design of process and product). For the most part, there persists a dependence on foreigners for the execution of new projects.

I believe that the major reason why skilled branches do the best is that, paradoxically, the process of de-skilling has progressed the least. The proposition that technological tacitness and nonreplicability are greatest the more skilled the commodity appears to be true; but this is not without virtue. It means that the acquisition of technology from abroad in the metalworking branches is least likely to be accomplished through turnkey imports. (Turnkeys are popular the more standardized the product, for example, chemical plants, textile mills.) Instead, the lesser codification of capital goods technology forces firms to participate actively in the technology acquisition process—which is effected most frequently by copying or foreign licenses. Through a process of active participation in technology transfer, a more intimate knowledge of systems design is acquired. This allows for better adaptive engineering, out of which arises the small, anonymous improvements in productivity mentioned above. Design of process and product, moreover, is more intimately connected technically in capital goods industries than in others. Therefore, adaptive engineering is itself conducive to gaining a capability in design. Thus, there is an interconnection or "virtuous circle" between production engineering and project execution in the capital goods sector that is absent or less pronounced elsewhere: project execution with (perforce) local involvement leads to greater adaptive engineering; and adaptive engineering and learning-by-doing lead to a greater ability to design. If the *NIC*s are light years away from establishing a local capability in systems engineering in most of the newer import-substitution sectors, they are within range of doing their own designs in many capital goods branches; for example, ships; offshore oil rigs; boilers; *CNC* lathes; special purpose, agricultural, and textile machinery, etc.

The feedback effects to and from production engineering and project execution are feebler even in the capital goods sector when copying is the exclusive means by which technology is acquired. This is because the scientific principles underlying a design are unlikely to reveal themselves in the process of copying. This makes reverse engineering more difficult. Thus, firms which must rely on copying alone to obtain their technology may be expected to perform less well than larger, more financially able firms. In fact, contrary to expectations, a sizeable percentage of capital goods output in Brazil, India, South Korea, and Taiwan is realized in firms which are large even by international standards. The interconnection between capability in production and design, moreover, is not automatic: it is rare to find a capital goods builder in a *NIC* which evolved from small to large without recurrent injections of foreign know-how and continuous local investment in technological learning.

We know that the greater the division of labor, the greater the degree of de-skilling and the use of capital; and implicit in production systems which have advanced furthest along these dimensions is a greater application of science to both product and process design. In addition, with a highly elaborate division of labor, functions such as *R&D* and production become more specialized. Hence, the more capital using the good, the greater the separation of production engineering and project execution, and the less the possibility of proficiency in one leading to proficiency in the other. Ignorance of design, however, may prove as great a handicap to exporting as incapacity to serve poses to winning in tennis.

III. Conclusions

It would be reductionist to attribute the impending competitiveness of skilled goods —which has already manifested itself in southern markets—to technological conditions alone. Differences in costs of skilled manpower and capital, in scale, and etc., may also distinguish the performance of sectors in the *NIC*s which rely largely upon skills rather than capital. But, just as one cannot explain adequately differences in the trade patterns of the developed countries in terms of factor endowments, so, too, the existence and unevenness of the technological capability of the *NIC*s must be acknowledged to explain their trade flows. This is all the more important given that capital in the *NIC*s cannot be taken as homogeneous: the technological element intrinsic in a stock of physical capital varies according to whether it is foreign or locally owned. How trade patterns may be expected to change, if at all, when account is taken of variations in ownership, I have not investigated.

Policy discussions heretofore have debated whether even to condone South-South trade, let alone to cradle it, under the assumption of its relative capital intensity. A policy of positive support, however, deserves serious consideration now that its skill intensity has been demonstrated.

A recognition of the skill intensity of South-South trade also compels a new construction of the term "intermediate technology," whose traditional connotation has been a middle ground of whatever sort: technology that is neither overly labor nor capital intensive; that is neither ultramodern nor backward; that is produced by medium-size firms, etc. In a three-factor world, of course, midway techniques in the old usage are meaningless but, more significantly, the technology underlying South-South trade may be intermediate only insofar as it tends neither to be the easiest nor the most difficult to transfer. Other dimensions of skill-intensive production may conceivably involve the latest technology and the largest firms.

Finally, whether the *NIC*s succeed in carving a new niche for themselves in the international division of labor will depend on technological changes in the skilled trades in the industrialized countries. The impending microelectronics revolution may squelch the *NIC*s' ambitions by raising the productivity of small batch production and by reducing the demand for skilled production labor. Agnosticism about this likelihood, however, is warranted: ever since the time of F. W. Taylor, we have been led to believe that the de-skilling of such industries is just around the corner.

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